

A new synonym from Hawaii and lectotypification of *Plagiothecium longisetum* (Plagiotheciaceae)

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Abstract

Plagiothecium mauiense was first described in 1927 by V.F. Brotherus, based on materials from Hawaii. It has, so far been, treated as a separate species. A detailed analysis of the original material housed in the New York Botanical Garden Herbarium (NY01256708) found the specimen to be characterised by a lack of metallic lustre; concave, asymmetrical, lanceolate to lanceolate-ovate leaves, shrunken in their dry condition; a straight, not denticulate, acute to apiculate apex; elongate-hexagonal cells in irregular transverse rows, $101\text{--}131 \times 15\text{--}21 \mu\text{m}$ at mid-leaf; very lax areolation, with decurrencies composed of three rows of cells. These characteristics indicate that this species is identical to the original material of *P. longisetum* (e.g. H-SOL 1563 011; PC0132572). Hence, we propose that *P. mauiense* should be recognised as a new synonym of *P. longisetum*. In addition, a review of *P. longisetum* syntypes found one (H-SOL 1563 011) to have the same date of collection as the protologue, and to possess a quite abundant gametophyte turf with well-preserved sporophytes, indicating it to be fertile. Considering the above, we propose that specimen H-SOL 1563 011 be designated the lectotype of *P. longisetum*.

Keywords

Codes of Botanical Nomenclature, *Orthophyllum* section, *Plagiothecium*, *Plagiothecium mauiense*, *Plagiothecium nemorale*, typification

Introduction

In this paper we demonstrate that all the characteristics of the original material of *P. mauiense* Broth. are identical to those of the *P. longisetum* Lindb. type. Hence, we propose *P. mauiense* as a new synonym of *P. longisetum*. In addition, among the three syntypes of *P. longisetum*, we propose the specimen (H-SOL 1563 011) deposited at the Herbarium of the University of Helsinki (Finland) as the lectotype of this name. The aim of the work is to demonstrate that *P. mauiense* and *P. longisetum* are synonyms, and to propose a lectotype for the name of the latter.

The study was based on herbarium specimens analysed during research conducted at the NY Herbarium (The New York Botanical Garden, New York, U.S.A.) from November to December 2018 and November to December 2019, as well as at the PC Herbarium (Muséum National d'Histoire Naturelle, Paris, France) in January 2019; and on specimens loaned from the H Herbarium (The University of Helsinki, Helsinki, Finland). However, due to renovation ongoing at the S Herbarium (The Swedish Museum of Natural History, Stockholm, Sweden) and the temporary closure of some herbaria, some less important specimens could not be examined; despite this, they are cited in the manuscript to present the most complete dataset possible. Specimens that were analysed directly were marked with an exclamation mark.

Plagiothecium mauiense account

In *Hawaiian Mosses*, V.F. Brotherus described a new species, *Plagiothecium mauiense*, based on materials collected by D.D. Baldwin from Hawaii (Brotherus 1927). In the diagnosis, the author indicated that, among others, the plant was relatively large, soft with a thick, light green to yellow green turf (“*robustiusculum, caespitosum, caespitibus, densiusculis, mollibus, lutescenti-viridibus*”); with loosely-arranged and complanate-foliate (“*laxiscule et complanate foliosus*”), decurrent (“*folia haud decurrentia*”), concave (“*concaviuscula*”), asymmetrical (“*asymmetrica*”), long-ovate leaves (“*ovate-oblong [sic.]*”); the leaf apex was short, acute to acuminate (“*breviter acumianta, acuta vel subula brevissima terminata*”); the leaves were 2.25 mm long and 1.1 mm wide (“*ad 2.25 mm longa et ad 1.1 mm lata, integra*”), costae were short and thin (“*nervis binis, brevibus, tenuibus*”); cells at mid-leaf are 12–15 × 75–100 µm (“*cellulis medianis folii 12–15 µm longis et 75–100 µm latis*”) (Brotherus 1927). Additionally, Brotherus (1927) added that the species *P. mauiense* was similar to *P. sylvaticum* (Brid.) Schimp., however, its cell areolation was narrower.

During the revision of *Plagiothecium nemorale sensu lato*, the original materials collected by D.D. Baldwin from Hawaii were found in four herbaria: Harvard University Herbarium (FH00220142), New York Botanical Garden Herbarium (NY01256708), Miami University Herbarium (MU 000000546), and Yale University Herbarium (YU 233890). On the envelopes of two specimens, from the MU and NY Herbaria, notes indicating them to be isotypes of *P. mauiense* were also found. In 1967, a similar note was added to the specimen from the NY Herbarium (NY01256708) by H.A. Miller, who studied this material (Fig. 1). Since that time, this specimen has served as the “iso-

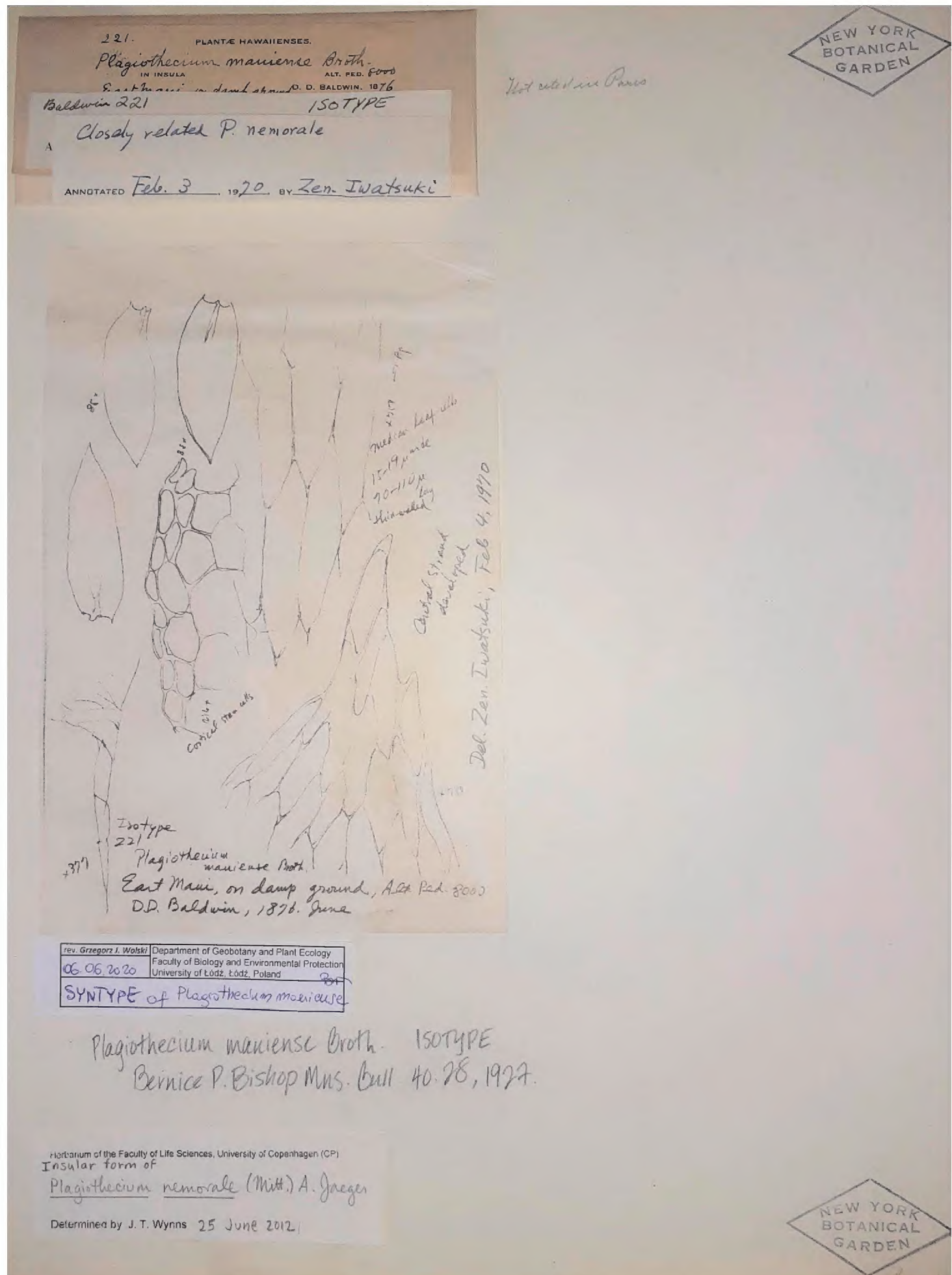


Figure 1. The syntype of *P. mauiense* (NY01256708) housed at the NY Herbarium.

type” (e.g. in the database of the Consortium of North American Bryophyte Herbaria, <https://bryophyteportal.org/portal/> – access: May 2020).

However, given the above, and according to Article 9.6 of the *Shenzhen Code* (Turland et al. 2018) stating that “A syntype is any specimen cited in the proto-

logue when there is no holotype, or any one of two or more specimens simultaneously designated in the protologue as types” as well as Article 40.2 (Note 1) stating that “When the type is indicated by reference to an entire gathering, or a part thereof, that consists of more than one specimen, those specimens are syntypes (see Art. 9.6.)”, all the above-mentioned original specimens of *P. mauiense* should be regarded as syntypes.

Three years later, on April 3, 1970, following a study by H.A. Miller, Z. Iwatsuki analysed the same material (NY01256708) and attached a note (dated April 4, 1970) to the examined specimen, together with hand-drawn pictures of its gametophyte (Fig. 1). Based on the remaining notes, it appears that Iwatsuki characterised the material as follows: stems with a developed central strand; leaves rather asymmetrical; decurrencies composed of one row; the apex very slightly denticulate; thin-wall cells in irregular transverse rows, at mid-leaf $15\text{--}19 \times 90\text{--}110\text{ }\mu\text{m}$. Additionally, Iwatsuki left a note that *P. mauiense* is closely related to *P. nemorale* (Mitt.) A. Jaeger (Iwatsuki 1970 unpubl.). However, in an analysis of *P. nemorale* in a taxonomic revision of the genus *Plagiothecium* published the same year, Iwatsuki (1970) does not mention *P. mauiense* or its similarity to this species.

Over 40 years later (June 25, 2012), the specimen deposited at the New York Herbarium (NY01256708) was reviewed by J.T. Wynns, who added the note: “Insular form of *Plagiothecium nemorale* (Mitt.) A. Jaeger”. In addition, in his revision of the genus *Plagiothecium*, he also added next to *P. mauiense* that the material did not differ from the type of *Stereodon nemoralis* Mitt. (being a basionym of *P. nemorale*) (Wynns 2015).

Despite the above-presented assumptions indicating that *P. mauiense*, recorded from Hawaii, is closely related or even identical to *S. nemoralis*, the two are still treated as separate species (see: Hoe 1974; Staples et al. 2004).

The features given in the diagnosis by Brotherus (1927), and indicated by Iwatsuki (1970 unpubl.) based on the analysis of the original material (Fig. 1), clearly qualify the described collections as a taxon representing the genus *Plagiothecium* and belonging to the section *Orthophyllum* Jedl. They even classified it as belonging to *P. nemorale sensu lato*. However, as some of the features given by Brotherus and Iwatsuki contradict each other, particularly the most taxonomically significant one, i.e. the length of the cells of the central part of the leaves, it is impossible to clearly assess this material.

Its light green to yellow green turf colour, leaf asymmetry and narrow cell areolation and irregular arrangement of cells reported by Brotherus (1927) and Iwatsuki (1970 unpubl.) are all characteristic of *P. longisetum*; in addition, Iwatsuki (1970 unpubl.) described the presence of a denticulate apex, corresponding to that of *P. nemorale*. Most importantly, the two authors differ in their opinion of the cell length at mid-leaf, one of the most taxonomically important features of this genus: Brotherus (1927) reported the length to be $75\text{--}100\text{ }\mu\text{m}$, which clearly matches *P. nemorale*, while Iwatsuki (1970 unpubl.) reported it as $90\text{--}110\text{ }\mu\text{m}$, corresponding to *P. longisetum*. In addition to the leaf cells, another very important feature of the whole genus, which is characteristic of individual sections, is the nature of leaf decurrencies (e.g. Nyholm 1965; Smith 2001; Wynns et al. 2017). Iwatsuki (1970 unpubl.) reported the presence of a single row of decurrent cells, which is a feature shared with representatives of section *Leptophyllum* Jedl. rather than section *Orthophyllum*, which is characterised

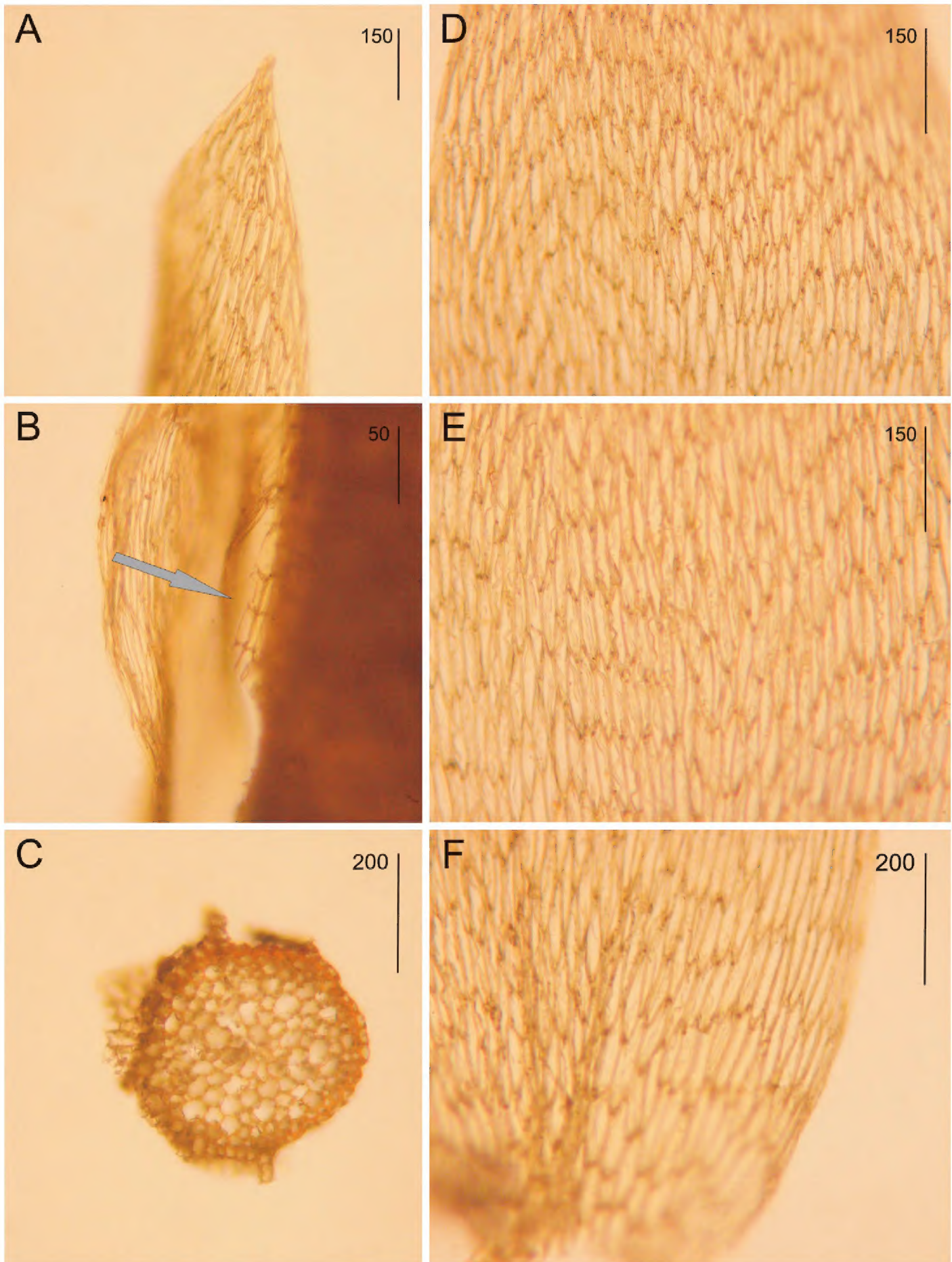


Figure 2. *Plagiothecium mauianse* from the NY Herbarium (*D.D. Baldwin 221*, NY01256708) **A** the plain leaf apex **B** the grey arrow indicates the three rows of decurrencies **C** the stem cross section **D–F** the shape and dimensions of cells from individual leaf zones: **D** from the upper part **E** from the middle part **F** from the lower part of the leaf. Scale bars: 50 µm (**B**); 150 µm (**A, D, E**); 200 µm (**C, F**).

by 2–3 rows of decurrent cells (Figs 1, 2). The remaining set of features provided by both authors are characteristic of both species: a large plant with a thick turf; loosely arranged and complanate-foliate; large (2.25 mm long and 1.1 mm wide), concave,

long-ovate leaves; two costae; an acute to acuminate apex; a developed central strand; thin-wall cells (Brotherus 1927; Iwatsuki 1970 unpubl.; Wolski 2017, 2018, 2020; Wolski and Nowicka-Krawczyk 2020).

The above-presented features and a detailed analysis of the specimen deposited at the New York Herbarium (NY01256708) indicated that this material represents *P. longisetum*. The specimen is large, light green to yellowish green, without metallic lustre; stems up to 2–2.5 cm long, complanate-foliate, rounded in cross-section, 330–380 μm in diameter, a developed central strand, epidermal cells 7–16 \times 14–24 μm , parenchyma thin-walled, 22–47 \times 19–43 μm ; leaves gently concave, asymmetrical, lanceolate to lanceolate-ovate, spreading, shrunken in dry conditions, those from the middle of the stem 2.5–2.7 mm long, and 1.1–1.5 mm in width, measured at the widest point; the apex straight, not denticulate, acute to apiculate; two costae, extending almost to $\frac{1}{2}$ leaf length, reaching 0.50–0.70 mm; elongate-hexagonal cells in irregular transverse rows, areolation very lax; cells reach 85–134 \times 15–20 μm at the apex, 101–131 \times 15–21 μm at mid-leaf, and 113–170 \times 18–25 μm at the lower part of the leaf; decurrencies of three rows of rectangular cells, 32–44 \times 15–31 μm (Fig. 2).

As only one syntype was examined (NY01256708), and due to the current inability to examine specimens from the other three herbaria (from FH, MU, YU), lectotypification of *P. mauiense* will be carried out later, once all original materials collected by D.D. Baldwin from Hawaii have been examined.

***Plagiothecium longisetum* account**

Lindberg described *Plagiothecium longisetum* in *Contributio ad Floram Cryptogamam Asiae Boreali-Orientalis* based on materials collected by C. Maximovicz from Japan (Lindberg 1872) (Fig. 3). After this fact, in the 19th and 20th centuries, the species was noted in the most important bryological studies of that time (Jaeger 1875–1876; Paris 1894–1898), however, it was not given from Europe, and its range was limited only to East Asia (China and Japan) (Schimper 1876; Lindberg 1879; Gravet 1883; Mitten 1891; Kindberg 1897; Brotherus 1929; Grout 1932; Podpéra 1954; Sakurai 1954).

At the beginning of the 20th century, Cardot (1912) indicated a relationship between *P. longisetum* and *P. sylvaticum*, writing that the former, similarly to *P. nemorale*, was just a form of *P. sylvaticum*. Wijk et al. (1967) indicated that *P. longisetum* was a synonym of *P. sylvaticum*, whereas Iwatsuki (1970) wrote that *P. longisetum* was a synonym of *P. nemorale*, adding that the former was only a habitat modification of the latter. After Iwatsuki (1970), for the next 50 years, this view spread throughout Europe and Asia (Lewinsky 1974; Iwatsuki 2004; Wynns 2015; Suzuki 2016). However, at the beginning of the 21st Century, as a result of a taxonomic revision of *P. nemorale sensu lato*, Wolski and Nowicka-Krawczyk (2020) proposed the resurrection of *P. longisetum*, and for it to be treated as separate from *P. nemorale*, which also was distributed in Eurasia. Subsequent studies have revealed a number of differences between the two species in the micromorphology of their sporophyte; they also documented their presence in North America, thus extending their global range (Wolski 2020; Wolski et al. 2020).

30. *Plagiothecium longisetum* n. sp. LINDB.

Dioicum, robustum; ramis arcuato-deflexis; foliis breviter acuminatis, nervo longiore et crassiore, cellulis duplo latioribus, perfecte rhombeis: seta longissima, flexuosa; thecae ore purpureo; peristomio minore et brevioris, multo intensius colorato, endostomio laevissimo, processibus latioribus ciliisque brevioribus, tenuioribus et vix nodulosis; operculo longiore et acutioris.

Hab. ad Nikosan ins. Kiusiu, fertile, 16 Junii 1863.

Cespites laxos, sed ob flagella copiosa intricatos, lurido- vel fulvo-viridulos paulloque nitentes formans. *Caulis* primarius 5—6 cm. longus, humifusus, tenuis, parvifolius, fusco-radiculosus, ramos emittens 2—3 cm. longos et 4—5 mm. latos, arcuatos, apice acutiusculo saepe flagellari-attenuatos et radiculiferos, vulgo supra basin ramulum simillimum, sed saepe

Contributio ad floram cryptogamam Asiae boreali-orientalis.

233

magis erectum proferentes, sat densifolios et complanatos. *Folia* vulgo leniter secunda, sicca leniter torta et undulata, longissime decurrentia, parte decurrente inferne sensim desinente, paullo asymmetrica, ovata, sat distincte acuminata, acumine brevi et latissimo, margine supra medium usque recurvo et ubique integerrimo, valde concava, nervo vulgo gemello, longiore et crassiore; *cellulae* laxissimae, magnae, subrhombae. *Perichætia* paucissima, 1 vel 2, supra basin rami axillaria, maxime fusco-radicantia. *Bractea* perichæti minutae, vaginantes, apice ovato-triangulares, acutae, margine ubique plano et integerrimo, nervo tenuiore, supra medium dissoluto, cellulis angustis, prosenchymatico-rectangularibus, laxissimis. *Vaginula* breviter conica, paraphyses et pistillidia paucissima gerens. *Seta* longissima, 4—5 cm. alta, vulgo hic illic valde flexuosa, rubra, superne flava, laevissima, sinistrorsum, supra medium dextrorsum torta. *Theca* sat parva, rubro-pallida, opaca, paullo nutans et asymmetrica, sicca quoque laevissima, oblongo-obconica, ore magno, purpureo, cellulis sat magnis et incrassatis, irregulariter rectangulo-quadratis, in collo sat longo stomatibus paucis, minutissimis, superficialibus. *Annulus* latus, triplex. *Exostomium* dentes 16, dolabriformes, acutissimi, transverse densissime striolati, superne papilloso et supra medium dense trabeculati, lutei; *endostomium* luteolo-pallidum, laevissimum, membrana ad dimidiam altitudinem exostomii elevata, processus altitudinis dentium, profunde carinati, acutissimi, medio haud vel vix perforati, cilia bina — quaterna, breviora, tenuissima, vix nodulosa. *Spori* minutissimi, laevissimi, ferrugineo-pallidi. *Operculum* luteolum, alte conicum, fere sensim angustatum in rostellum dimidia longitudine capsulae, suberectum et acutum. *Calyptra* straminea, apice brunneola, nitida, laevissima, ad medium thecae dependens.

Planta mascula nobis ignota.

Affinissimum *Plagiothecium silvaticum* (HUDS.) B. S., quod in Japonia quoque creseit, secundum specimina a clar. TEXTOR lecta, facile distinguitur, diagnosi, supra data, collata, ut et parte decurrente folii inferne magis abrupte desinente, apice folii acuto, margine ejus magis et altius recurvo, foliis minus concavis, cellulis duplo angustioribus et minus incrassatis.

Figure 3. The diagnosis of *Plagiothecium longisetum* (Lindberg 1872).

During this revision, the specimens on which Lindberg (1872) described *P. longisetum* were found in three herbaria: the University of Helsinki Herbarium (H-SOL1563011), the Herbarium of Swedish Museum of Natural History (S-B160017) and Muséum National d'Histoire Naturelle (PC0132572). The latter specimen is marked as the “isotype” (Fig. 4). Based on this information, and according to Article 9.6 and 40.2 Note 1 of the *Shenzhen Code* (Turland et al. 2018) cited above, all specimens listed above should be considered syntypes.

In addition to the description of gametophyte morphology given in the diagnosis of *P. longisetum*, Lindberg (1872) indicated that this material has sporophytes (i.e. is “fertile”) and was collected on 16 June, 1863 (“16 Junii 1863”) near Nikosan on Kyushu island (“ad Nikosan ins. Kiusiu”) in Japan (Fig. 3). Addition-

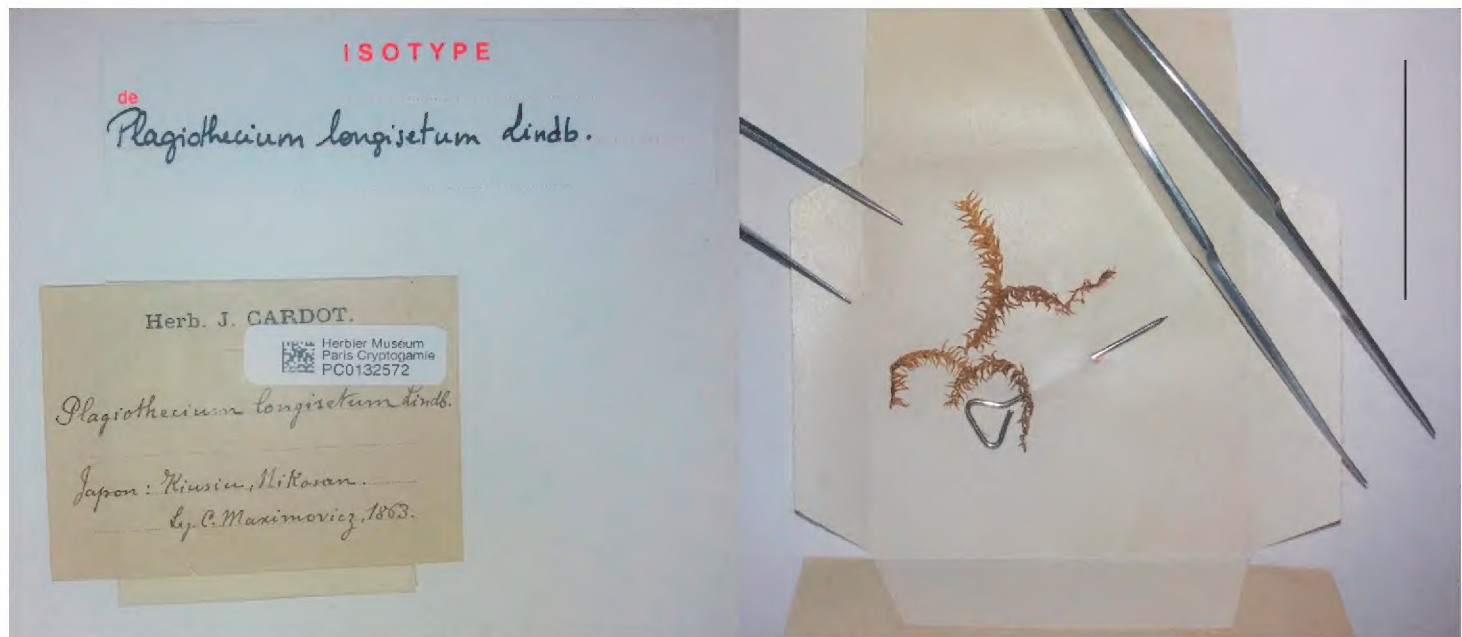


Figure 4. Sheet of *Plagiothecium longisetum* marked as the “isotype” and three stems of gametophyte deposited in the herbarium of the Muséum National d’Histoire Naturelle (PC0132572). Scale bar: 3 cm.

ally, Lindberg (1872) indicates, among others, that *P. longisetum* is characterised by a very long seta (“*seta longissima*”) and a long operculum (“*operculo longiore et acutiore*”). The presence of such a long seta, i.e. up to 5 cm in length, and a long operculum, distinguish the sample from other species of *Plagiothecium*; these characteristics, combined with the gametophyte features, are unique to *P. longisetum* (Wolski and Nowicka-Krawczyk 2020).

The specimen deposited at the herbarium in Helsinki (H-SOL 1563 011) was awarded the same date of collection as in the prologue, and is characterised by a fairly large, well-preserved gametophyte turf with three sporophytes (Fig. 5). The material deposited in Stockholm (S-B160017) also has a full collection date; however, due to the ongoing renovation of this herbarium, the loan and subsequent analysis of this material is impossible. Unfortunately, the specimen housed in the herbarium in Paris (PC0132572) has an incomplete collection date (“1863”), and only three gametophyte stems, without sporophytes (Fig. 4).

The material deposited in Helsinki (H-SOL 1563 011) is distinguished from other analysed syntypes by the presence of a fairly large gametophyte turf and more importantly, well-preserved sporophytes (Fig. 5), which (as Lindberg described in the diagnosis) confirm that the specimen is prolific (“*fertile*”). Based on these facts, and according to Article 9.3 of the *Shenzhen Code* (Turland et al. 2018) cited above, we propose that specimen H-SOL1563011 should be designated as the lectotype of *P. longisetum* (Fig. 5). In addition, due to the fact that the specimen from Muséum National d’Histoire Naturelle (PC0132572) was examined at the beginning of 2019, and we did not have access to the specimen deposited at the Herbarium of the Swedish Museum of Natural History (S-B160017), a request was sent to both institutions to change the status of these specimens to the isolectotype.

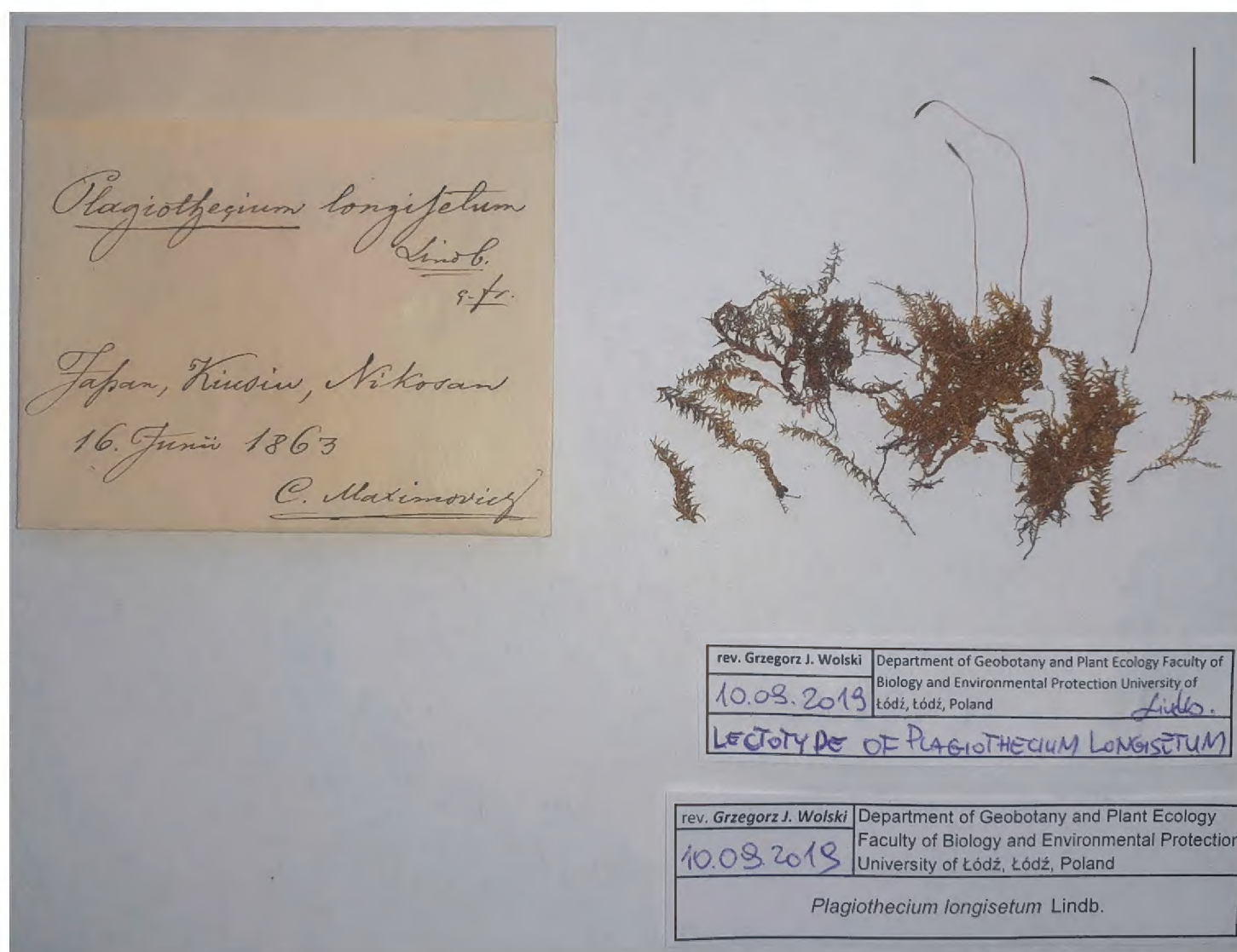


Figure 5. Envelope and turf with sporophytes of *Plagiothecium longisetum* from the University of Helsinki Herbarium (H-SOL 1563 011). Scale bar: 2 cm.

Taxonomic treatment

Plagiothecium longisetum Lindb., Acta Soc. Sci. Fenn. 10: 232 (1875). – Lectotype (designated here): [Japan], ad Nikosan ins. Kiusiu, [fertile], 16 Junii 1863, S.O. Lindberg s.n. (lecto-: H-SOL 1563 011!, isolecto-: PC0132572!, S-B160017) = *P. mauiense* Broth., Bernice P. Bishop Museum Bulletin 40: 28 (1927), syn. nov. Type: [United States], Hawaii, E Maui, Haleakala, 8000 ft., in damp ravines, fertile, June 1876, D.D. Baldwin 221 (syn-: NY01256708!, FH00220142, MU000000546, YU233890).

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